AS and A-level Computer Science New Specification Launch

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Structure of the session

Overview of the new AS and A-level specifications
- Underlying principles and key features
- Specification at a glance for each
- Summary of content and assessment objectives

A-level Papers 1 and 2
- Content summary
- The question papers and question types

A-level non-exam assessment (NEA)
- Criteria and assessment
- Administration

AS assessment

Support and resources

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Context

- AS and A-level Computing required to change because :
  - subject title changed to Computer Science by DfE
  - new Subject Criteria, now renamed Subject Content, reflecting Computer Science published by DfE
- AQA AS and A-level new Computer Science specifications have been approved by Ofqual
- For teaching from September 2015
- *First AS assessments in summer 2016*
- *First A-level assessments in summer 2017*

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Underlying principles 1

Subject

To develop a subject specification that

- truly reflects the essence of Computer Science
- reveals the subject to be an important, fundamental, academic discipline underpinning other subjects
- enables students to
  - develop their problem solving skills
  - exercise their creativity
  - explore their interests

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Underlying principles 2

Specification development

To evolve the current market-leading, well respected AQA GCE Computing specification to

- reflect the increased focus on Computer Science
- ensure content is fresh for those students who have studied a GCSE CS course yet accessible for those who have not
- offer a student and teacher friendly NEA with greater emphasis on technical solution and slimmed down documentary evidence
- create two separate qualifications which are co-teachable

To work closely with teachers, subject associations and Higher Education stakeholders as well as subject experts to produce the best possible outcome for all parties

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Why choose AQA AS and A-level CS specifications?

- A qualification for all abilities at AS and A-level valued by HE, development informed by teachers, subject experts, BCS, CAS and HE input
- Interesting content, aligned with HE subject therefore continuing respect, admiration and support of HE gained with the current specification
- Specification is well supported:
  - bank of current specification past papers
  - teaching resources for current specification reusable
  - new resources and support to help teaching and learning
- Attractive NEA in any programming language with
  - emphasis on technical solution and not on documentation
  - Investigative type projects supported, eg machine learning algorithms

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Key features and benefits 1

- Focus on principles, concepts and skills that will
  - stand the test of time
  - be deliverable in an interesting, up-to-date, practical and relevant manner
  - build on the strengths of AQA's current Computing specification
- Follows on from the big shift to a true Computer Science A-level specification made by AQA back in 2009 so:
  - builds on the experience gained from delivering the current specification
  - continues with a similar ethos, with changes to content reflecting developments in the field now considered important to teach
- Programming skill, K & U tested by reliable, on-screen exam (AS and A-level), in programming language chosen from a range of possible languages

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Key features and benefits 2

- Accommodates students who have had GCSE CS experience and those who haven't
- Recognises that developing problem solving skill takes time so focus in first year on developing and debugging programmed solutions to problems with flexibility for teacher/student to choose problems to solve
- A-level exposes students to:
  - key programming paradigms
  - advanced data structures
  - traversal, search, sort and optimisation algorithms and their efficiency
- Engaging approach to moral, ethical, legal and cultural opportunities and risks from perspective of a computer scientist devising algorithms and writing code
- Opportunities to explore and engage with the changing technology scene: scaling issues, Cloud services, Big Data, cheap programmable devices such as the Raspberry Pi

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A-level: Subject content summary

1. Programming – imperative procedural-oriented, OOP, recursive techniques
2. Data structures – arrays, lists, dictionaries, hash tables, queue, graph, tree, stack, vector, fields, records, files (text & binary)
3. Algorithms – traversal, search, sort, optimisation
4. Theory of computation – abstraction, automation, FSM with and without output, language hierarchy, complexity, Turing machines
5. Data representation – number systems/bases, information coding systems, encryption
6. Computer systems – logic gates, Boolean algebra, program translator types, classification of programming languages, system software
7. Computer organisation and architecture – machine code/assembly language, CPU, internal components of computer, external hardware devices (limited range)
8. Consequences of uses of computing – software and their algorithms embed moral & cultural values, issue of scale brings potential for great good but also ability to cause great harm, challenges facing legislators
9. Communication and networking – communication methods/basics, network topology, wireless, the Internet, TCP/IP, CRUD applications and REST, JSON, JavaScript
10. Databases – data modelling, relational database, SQL, client server databases
11. Big Data – volume/velocity/variety, fact-based model, distributed processing and functional programming
12. Fundamentals of functional programming – function type, first-class object, function application, partial function application, composition of functions, map, filter, reduce, lists
13. Systematic approach to problem solving – skills needed for Paper 1 and NEA
14. NEA - The computing practical project

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AS: Subject content summary

1. Programming – imperative procedural-oriented
2. Data structures – arrays, fields, records, files (text & binary)
3. Systematic approach to problem solving – analysis, design, implementation, testing, evaluation
4. Theory of computation – abstraction, automation, FSM without output
5. Data representation – number systems/bases, information coding systems, encryption
6. Computer systems – logic gates, Boolean algebra, program translator types, classification of programming languages, system software
7. Computer organisation and architecture – machine code/assembly language, CPU, internal components of computer, external hardware devices (limited range)
8. Consequences of uses of computing – software and their algorithms embed moral & cultural values, issue of scale brings potential for great good but also ability to cause great harm, challenges facing legislators
9. Communication and networking – communication methods/basics, network topology, wireless

AS content is a subset of the A-level content that can be taught in the first year. Some A-level topics are completely omitted from the AS eg functional programming) and other are only partially covered (eg data structures topic at AS only covers arrays or similar) .

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AS and A-level: Assessment at a glance

AS

Paper 1	50% of A-level	On screen exam 1½ hours 75 marks
Paper 2	50% of AS level	Paper exam 1½ hours 75 marks

A-level

Paper 1	40% of A-level	On screen exam 2½ hours 100 marks
Paper 2	40% of A-level	Paper exam 2½ hours 100 marks
NEA	20% of A-level	75 marks

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AS and A-level: Assessment objectives

AO1	Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation
AO2	Apply knowledge and understanding of the principles and concepts of computer science, including to analyse problems in computational terms
AO3	Design, program and evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions

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AS and A-level: Co-teaching models

1. AS students take AS exam after studying AS course
2. A-level students take A-level exam after studying A-level course
3. AS exam result does not count towards A-level result
4. AS and A-level students can study together because AS is a subset of A-level

Possible scenario:

- AS course run over one year
- A-level course run over two years
- AS and A-level students taught in same class in first year of A-level course

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Maths content

DfE Subject Content for CS specifies maths content for:

- AS
  - Boolean algebra
  - Number representation and bases
- A-level
  - Boolean algebra
  - Number representation and bases
  - Comparison of complexity of algorithms

- The required maths content has been integrated into the AS and A-level specifications in a supportive manner
- Some set theory is covered to support data typing, number representation, functional programming, and because it is important to CS and was requested by HE
- Much of the maths content already contained in AQA GCE Computing specification since 2009 so past paper questions available
- Support available for this content in the approved textbooks (available spring 2015)

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Key changes for current AQA centres

- Simplified NEA
- Main subject content changes:

New topics	Topics that have gone
Greater emphasis on OOP More assembly language programming Fundamentals of functional programming Critical understanding of social issues Hash tables, dictionaries, lists, vectors Dijkstra's shortest path, merge sort Some maths content (next slide) Updated networking content eg focus on wireless	Declarative languages HTML & CSS Detailed knowledge of laws Linked lists Insertion sort Simulation Software and OS classification Many input and output devices Gray Code, Hamming Code Decision Tables, Flowcharts Systems development lifecycle from exam

- See AQA website for a more detailed list of changes and also comparisons to current specifications from other Awarding Bodies: http://www.aqa.org.uk/subjects/ict-and-computer-science/a-level/computer-science-as-draft/supporting-resources/core-materials

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A-level: Paper 1

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A-level: Content and skills for Paper 1

An on-screen examination that tests a candidate's ability to program as well as the theoretical knowledge of Computer Science from the following topics:

- Fundamentals of programming
- Fundamentals of data structures
- Fundamentals of algorithms
- Theory of computation

Focuses on the designing, writing and testing of programs

Available in a wide range of programming languages (C#, Java, Pascal/Delphi, Python (2,3), VB.Net)

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A-level: Why test programming in an exam?

- Tests general and specific programming and debugging skills, K & U in contexts of one or more of the following in a series: recursion, object-oriented programming, complex data structures
- A more realistic assessment than writing pseudo-code on a written paper because
  - pseudo-code does not deal with implementation issues such as efficiency and data representation
  - pseudo-code does not give students access to debugging tools that programmers use or the ability to run and test their programs
- Has worked very well for the current AS Computing specification

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A-level: Structure of Paper 1

- Prior to the exam, candidates issued with Preliminary Material, the Skeleton Program, and, where appropriate, test data for use in the exam
- This material will be made available in centres in the autumn term of the second year so that centres have time to prepare students for the exam without it interfering with NEA
- Students answer series of short questions and write/adapt/extend programs in an Electronic Answer Document provided by AQA
- Based on the current model that has been successfully used by AQA at AS for several years
- Includes synoptic and extended response questions

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A-level: Paper 2

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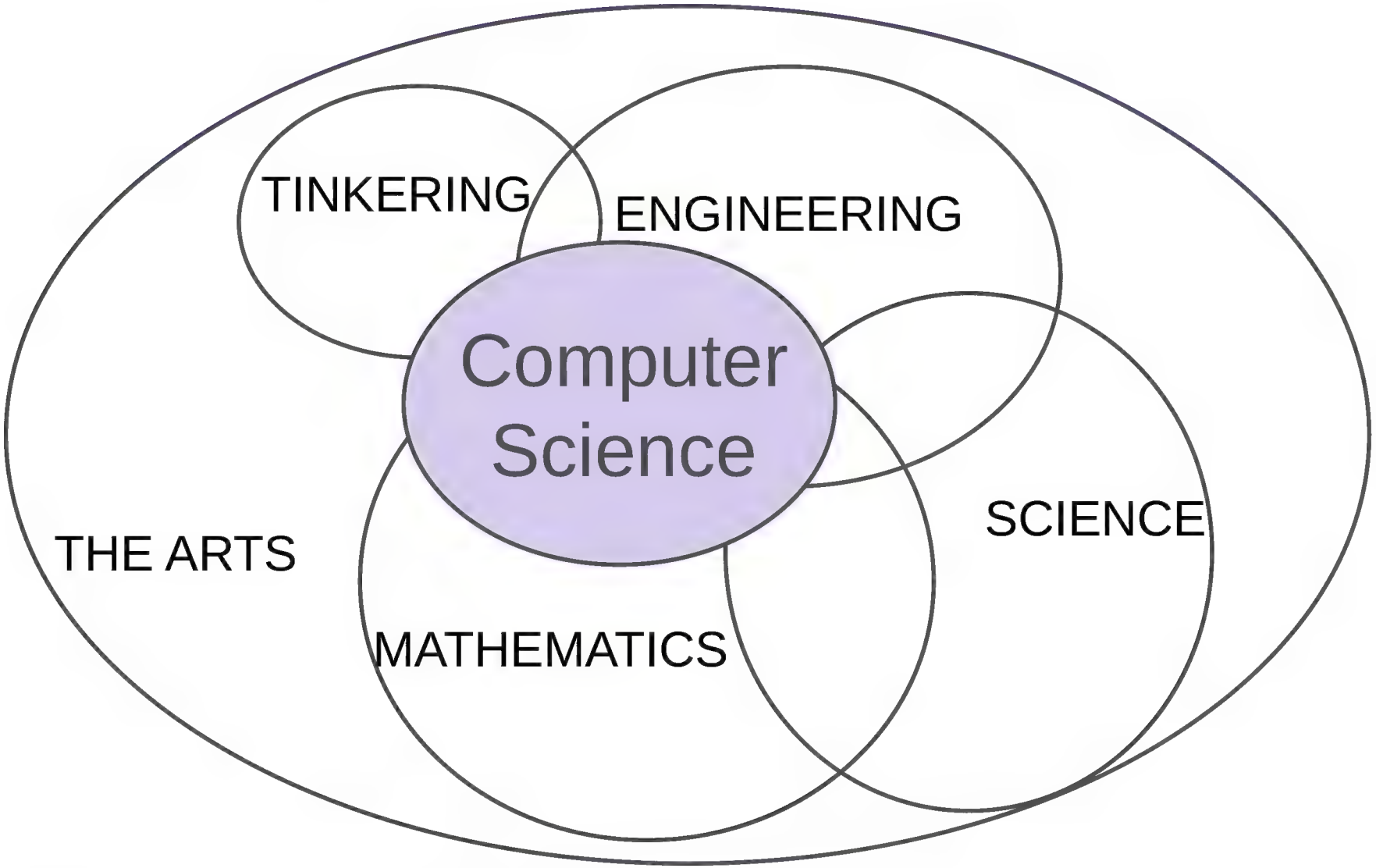
A-level: Paper 2



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A-level: Content and skills for Paper 2

Tests a candidate's ability to answer questions on the following topics:

- Fundamentals of data representation
- Fundamentals of computer systems
- Fundamentals of computer organisation and architecture
- Consequences of uses of computing
- Fundamentals of communication and networking
- Fundamentals of databases
- Big Data
- Fundamentals of functional programming

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A-level: Structure of Paper 2

- Compulsory short answer and extended answer questions
- Includes synoptic and extended response questions

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A-level: Non-examined assessment

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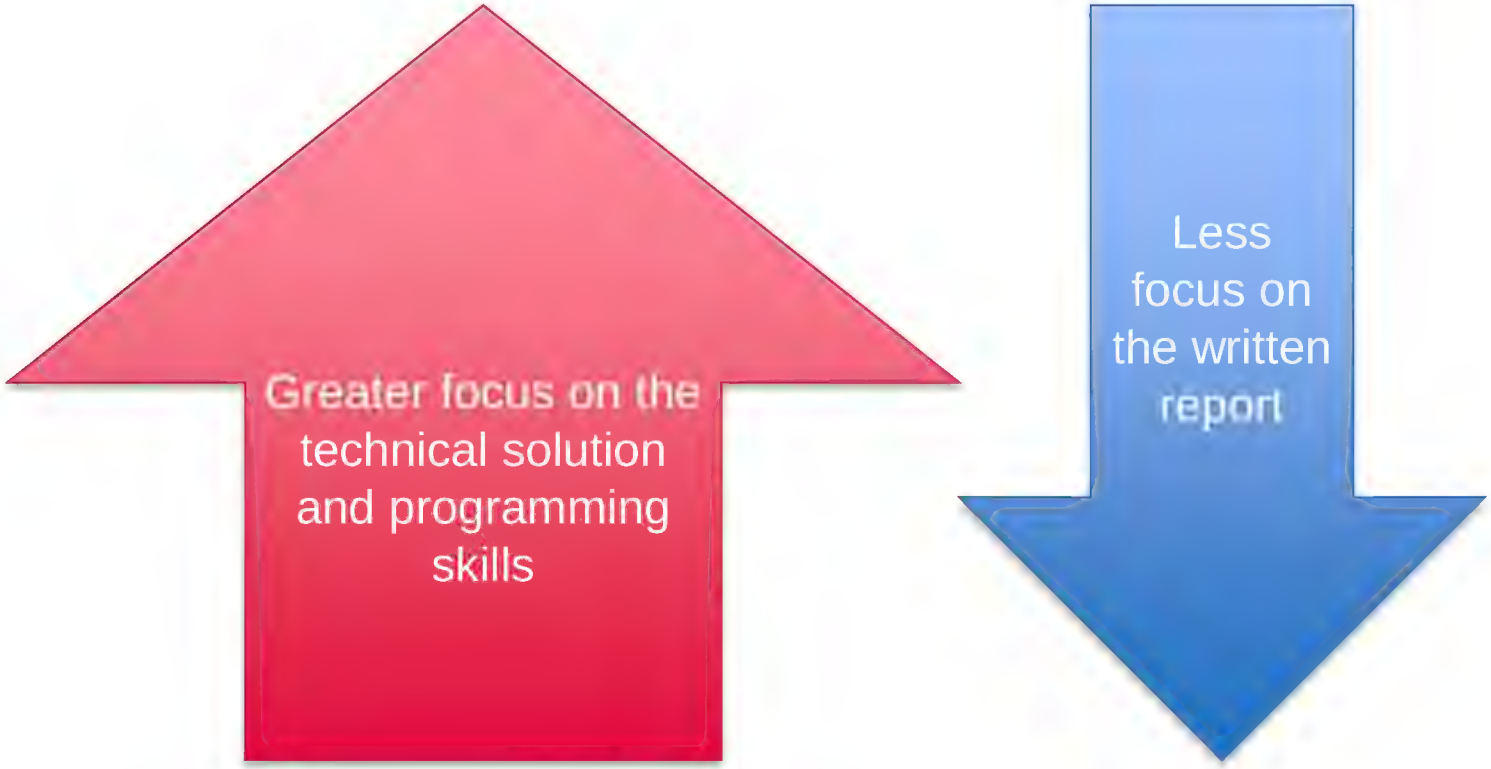
A-level: Non-examined assessment (NEA)

Key considerations for the new specification:



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A-level: NEA Background

- We included an open-ended NEA project as it:
  - is an opportunity to work on a significant task from start to finish
  - leads on to the type of work students will be required to complete in HE
  - Allows students to work on a project that matches their interests, ability and previous experience
  - can bring together skills developed in various parts of the course.
- Can be completed using any programming language(s), not just the ones that students can use for Paper 1
- Expected to be completed in the second year of the A-level (but this is not a requirement)

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A-level: What's different about this NEA?

- Slimmed down documentation requirements
- More marks allocated to the programming that the student has done (56%)
- The level of complexity concept, used in the previous A-level Computing has been removed
- There is now the opportunity to do investigative projects as an alternative to developing a system for an end user
- No expectation that a particular software development methodology is used or documented

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A-level: Example NEA tasks

- A simulation eg of a business or scientific nature, or an investigation of a well-known problem such as the game of life
- A solution to data processing problem for an organisation, eg membership systems
- The solution of an optimisation problem, eg production of a rota, shortest-path problems, route finding
- A control system, operated using a device such as an Arduino board
- A website with dynamic content, driven by a database back-end
- An app for a mobile phone or tablet
- Investigating machine learning algorithms
- Investigating an area of data science using, for example, Twitter feed data or online public data sets

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A-level: NEA mark allocations

Analysis	9 marks
Documented design	12 marks
Technical solution (Completeness of solution (Techniques used	42 marks 15 marks) 27 marks)
Testing	8 marks
Evaluation	4 marks
Total	**75 marks**

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A-level: NEA admin

- Some work must be completed under direct supervision to ensure that the work submitted can be confidently authenticated as their own
- Online teacher standardisation offered
- Teachers mark and annotate work before internally standardising where necessary
- Marking checked by an AQA Moderator initially using a sample of your student's work

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AS level

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AS overview

- Same assessment structure as A-level
- Different assessment durations (3 hours rather than 5 hours)
- AS content is a subset of the A-level content
- The nature of the Skeleton Program and the Preliminary Material will reflect the different level of demand eg no object-orientation, recursion
- No NEA

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AQA ongoing support and resources

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AQA ongoing support and resources

- Free preparing to teach events
- Free coursework standardisation
- Allocated Coursework Adviser
- AQA website
- e-AQA including
  - Secure Key Materials
  - ERA (Enhanced Results Analysis)
- Training courses

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Other resources

- Exampro
- Teach it
- Alfie
- CAS resource bank

Approved textbooks and electronic resources from:

- Hodder Education
- Educational Computing Services Ltd

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Timeline

Draft
Specification and specimen Question Papers, and Mark Schemes published

Accredited
Specification published

First teaching
AS and A-level courses

First assessment
AS

First assessment
A-level

Teacher and learner resources published

Additional **teacher and learner resources** published

FREE Introductory events online and face to face

FREE Preparing to teach events

Teacher training courses available

Summer 2014	Autumn 2014	Spring 2015	Summer 2015	September 2015	Summer 2016	Summer 2017

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AQA

Contact points for more information and guidance

- Computer Science subject team
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  0161 957 3980

- Teacher Support and CPD Managers
  0161 957 3646
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- AQA Website
  www.aqa.org.uk

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